

CLAIMS

1. A method of analysis of a wavefront based on local measurement of the slope of the wavefront, the method 5 comprising a stage (34) of acquisition of the wavefront consisting of:

- a stage of detection of the wavefront in particular by means of an array (ML) of microlenses (L_i), a detector (DET) and signal processing means, each microlens (L_i) 10 defining a subaperture (SP_i), indexed, and focusing a surface element of the wavefront, intercepted by the said subaperture, to form a spot (T_i) on the detector supplying a signal, a zone (Z_i) of assumed localization of the spot on the detector being defined for each subaperture,
- 15 - a stage of processing of the signal supplied by the detector making it possible in particular to establish a measurement file (35) associated in particular with each subaperture in the localization zone of which a spot is detected, the position of this spot, each subaperture being referenced by its index, the method being characterized in that it includes in addition:
- * prior choice (30) of an array (ML) of microlenses exhibiting at least one local variation of its structure,
- * a preliminary stage (31) of characterization of this 25 array making it possible to establish a reference file (32) in particular associating with each subaperture, referenced by its index, the position of the spot originating from the said subaperture when the subaperture is illuminated by a known wavefront, the file data including a contribution due 30 to the local variation of the structure of the array,
- * during each analysis (33) of a wavefront,
- establishment of the measurement file (35), the file data also including a contribution due to the local variation of the array structure,
- 35 - comparison (36) of the said contributions taken from each of the two files, this comparison making it possible to determine any displacement (37) in number of subapertures between these two contributions and deduce therefrom, with certainty, the correspondence between a detected spot and 40 the subaperture from which it originated,

- knowing this correspondence, on the basis of the measurement file and the reference file, calculation (38) of the average slope of the wavefront on each surface element intercepted by each subaperture illuminated by the 5 waveform.

2. A method according to claim 1, characterized in that the reference file (32) only includes a contribution due to the local variation and in that the contribution due to the local variation in the measurement file is obtained by 10 application, to the said file, of high-pass filtering (361) adapted to the said variation, the displacement (37) between the two contributions then being determined by comparison (363) of the reference file (32) and of the measurement file after filtering (362).

15 3. A method according to claim 1, characterized in that the contributions due to the local variation in the measurement file and in the reference file are obtained by application, to the two files, of the same high-pass filtering (361), the displacement (37) between the two 20 contributions being determined by comparison (363) of the two files after filtering (362, 364).

Sub A1 4. A method according to one of the claims 2 or 3, characterized in that the phase of the wavefront to be analysed being resolvable on a base of known polynomials, 25 the high-pass filtering (361) applied to a file consists of subtracting, from this file, the contributions due to a given number of these polynomials.

30 5. A method according to one of the claims 3 or 4, characterized in that comparison (363) of the files after filtering is carried out by means of a correlation operation.

35 6. A method according to claim 1, characterized in that comparison (36) is carried out by applying, to one of the two files (32, 35), a hypothetical value of displacement, effecting a subtraction between the file thus obtained and the other file, and iterating the displacement value applied so as to determine for what value of displacement, the contribution due to the local variation in the file resulting from the subtraction is the smallest.

Sub A2 40 7. A method according to one of the preceding claims, characterized in that it comprises in addition a stage (39) of reconstruction of the phase of the wavefront, making it possible in particular to determine the exact value of the deflection of the wavefront.

8. A device for wavefront analysis comprising in particular an array (ML) of microlenses (L_i), a detector (DET) and signal processing means, each microlens (L_i) defining a subaperture (SP_i), indexed, and focusing a surface element of the wavefront, intercepted by the said subaperture, to form a spot (T_i) on the detector supplying a signal, a zone (Z_i) of assumed localization of the spot on the detector being defined for each subaperture, the processing means making it possible to process the signal supplied by the detector in order in particular to establish a measurement file (35) associating in particular, with each subaperture in the localization zone from which a spot is detected, the position of this spot, each subaperture being referenced by its index, the device being characterized in 15 that:

- * its array (ML) of microlenses has at least one local variation of its structure, this array being characterized beforehand so as to establish a reference file (32) associating in particular, with each subaperture, referenced by its index, the position of the spot originating from the said subaperture when the subaperture is illuminated by a known wavefront, the file data including a contribution due to the local variation of the structure of the array,
- * the measurement file (35) also includes a 25 contribution due to the local variation of the structure of the array,
- * the processing means permit in addition
 - establishment of the measurement file (35), the file data also including a contribution due to the local variation of the structure of the array,
 - comparing the said contributions taken from each of the two files, this comparison making it possible to determine any displacement (37) in number of subapertures between these two contributions and deduce therefrom, with certainty, the correspondence between a detected spot and the subaperture from which it originated,
 - knowing this correspondence, on the basis of the measurement file and of the reference file, calculation of the average slope of the wavefront on each surface element 35 intercepted by each subaperture illuminated by the wavefront.

9. A device according to claim 8, characterized in that at least one local variation of the structure of the array is an uncontrolled defect of the array due to the non-reproducibility of the method of manufacture of the array.

Sub A37 10. A device according to claim 8 or 9, characterized in that at least one local variation of the structure of the array is a controlled variation, introduced during manufacture of the array.

11. A device according to one of the claims 8 to 10,
10 characterized in that the general form of the frequency
distribution of the slopes of the wavefront being known,
local variations are introduced into the structure of the
array in such a way that the frequency distribution of the
contribution due to these local variations is adapted to the
15 said general form.

15 said claim.
12. A device according to one of the claims 8 to 11,
characterized in that at least one local variation of the
structure consists of a difference in the position of one or
more adjacent microlenses, the contributions taken from each
20 of the two files to be compared (36) being the contributions
due to the local variation in the positions of the spots.

13. A device according to one of the claims 8 to 12, characterized in that at least one local variation of the structure consists of a variation in transmission of one or more adjacent microlenses, the files (32, 35) in addition associating with each subaperture, the intensity of the spot originating from the said subaperture, the contributions taken from each of the two files to be compared (36) being the contributions due to the local variation in the intensities of the spots.